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*New or Little Known Reptiles from the Trias of Arizona
and New Mexico with Notes on the Fossil Bearing
Horizons Near Wingate, New Mexico.*

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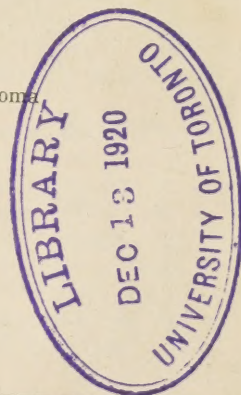
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PREFACE

The present work consists of a series of papers on new or little known reptiles from the Triassic of New Mexico and Arizona, and includes a brief description of the geology and lithology of the Triassic fossil bearing horizons near Fort Wingate, New Mexico. As indicated, the second paper was prepared jointly by M. G. Mehl and G. M. Schwartz. The paper by Mr. W. C. Toepelmann was prepared under the supervision of Mr. Mehl who accepts all responsibility for the figures and statements.

The Triassic vertebrate collections of the University of Chicago and the University of Wisconsin were very generously placed at the disposal of the senior author of this bulletin. The Wisconsin material was collected in Arizona and New Mexico as indicated on the following pages, by the University of Wisconsin Paleontological Expedition of 1914 under the direction of M. G. Mehl. The University of Chicago material described hereafter is a part of the Triassic collection made by Dr. S. W. Williston and Mr. P. C. Miller in Arizona and New Mexico in the fall of 1913. In both collections there remains much that should add materially to the knowledge of the Triassic vertebrate life of the West. It is thought well, however, to publish at this time, the results of the study of the material now available.

Specimens number 3807, 3808, 3809, 3810, and 3811 of the U. of W. collections are figured and described through the courtesy of the department of geology of the University of Wisconsin. For the use of specimens 1251 and 1252 of the University of Chicago collections and for other materials the authors wish to thank Dr. Williston. The senior author of the bulletin is especially indebted to Dr. Williston for kindly criticisms and suggestions offered in the course of preparation of the work.

M. G. MEHL.



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NEW OR LITTLE KNOWN PHYTOSAURS FROM ARIZONA

Maurice G. Mehl

In the spring of 1914 the writer, with the assistance of Mr. G. M. Schwartz, a student in the University of Wisconsin, spent two months in Arizona and New Mexico collecting Triassic vertebrates and making geological investigations in the interests of the University of Wisconsin. In Arizona it was possible to prospect over but a very limited area, a small stretch of hills on the northeast side of the Little Colorado River about fifty miles north, a little east of Flagstaff. The horizon and locality investigated is apparently the same as that described by Ward in 1901 (1), viz., two miles east of Tanner's Crossing and perhaps two hundred feet above the Lithodendron member of the Shinarump group of the Triassic. Phytosaur remains are by far the most common and best preserved vertebrate fossils to be found here. In the Phytosaur material collected by the Wisconsin party there are apparently two distinct types as described below.

Machaeroprotopus validus, Gen. and Sp. Nov.

The material on which this genus and species are based, No. 3807 U. W., consists of a large skull and the associated lower jaws. Several other phytosaur specimens were found nearby, but none of them are sufficiently well preserved to be referred to this species with certainty. At least two of them, Nos. 3808 U. W. and 3809 U. W., are generally identical, however.

When found, the skull lay with the palate surface up. Directly below lay the mandible in the normal position. The right mandible back of the symphysis was broken into large fragments and scattered down the wash as was the palate and certain other minor parts of the skull. The rostrum is twisted slightly to the right, but this is apparently the only deformation that the specimen has suffered. The condition of the material permits an accurate restoration and the determination of most of the essential features of the skull save for the palate portion. As to its preservation the specimen is one of the best so far discovered

(1) Am. Jour. Sci., 4th ser., vol. XII, 1901, p. 413.

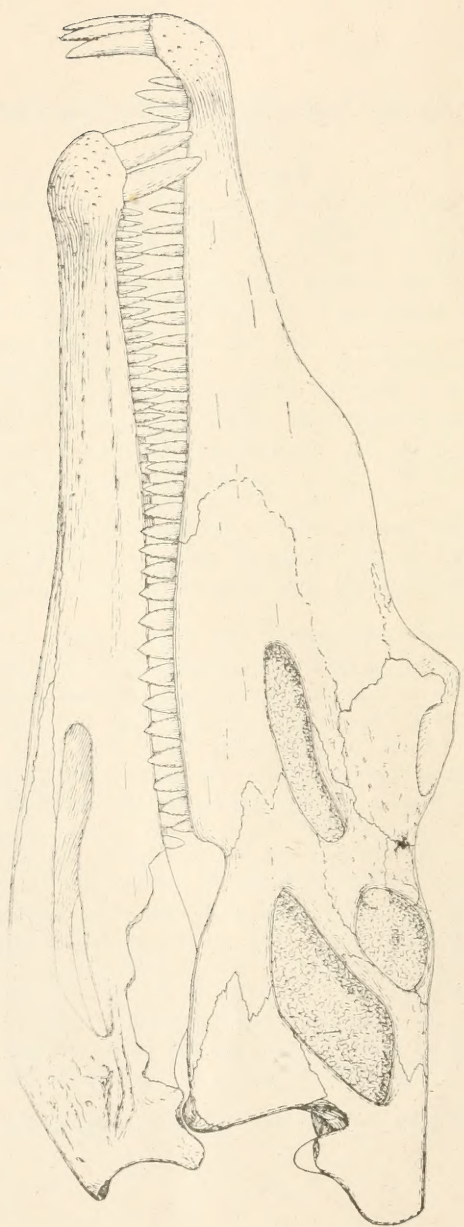


Fig. 1. *Machaeroprotopus calidus*, lateral view of skull and mandible, about two-thirteenth natural size.

in the Trias of North America and represents in addition, the largest phytosaur yet recorded.

The skull is of the type of *Lophoprosopus (Belodon) kapffi* (1) and in a lateral view resembles that form rather closely in as much as each has a well developed rostral crest. Unlike the rostrum of the other crested phytosaurs, however, that of the present specimen is not continuous in its upper outline, but presents a sinuous border. The crest springs from a prominent rugosity just in advance of, and slightly above the nares. From here the border curves sharply downward and forward concavely for a distance of about 70 mm. and thence forward a distance of 160 mm. in a nearly horizontal line. From this point the outline again turns downward and forward in a concave curve, but loses its identity some 120 mm. back of the extremity of the rostrum.

The crest also differs from that of the European form in that it does not present the swollen edge of the latter, but is thin and knife-like.

OPENINGS OF THE SKULL.

In considering the openings in the skulls of the various genera and species of the Phytosauria it is evident that they vary considerably in their relations to each other. This variation in the position of the openings, especially that of the nares, has been employed more or less in specific descriptions; in some cases the position of the nares has been made a distinguishing feature of the genus, perhaps correctly. A distinction of this sort is apt to be confusing, however, as there has been no accepted "fixed" point on the skull to which to refer measurements. The results of investigations of the writer in this direction suggest the center of the orbit as such a fixed point (2).

(1) Mehl, The Phytosauria of The Trias, Jour. Geol., Vol. XXIII, 1915, p. 163.

(2) Figures of the several described genera, drawn to the same size and in their correct proportions, show that the variation in the distance between the center of the orbit and the occipital condyle is very slight; that is, the orbit appears to be a fixed point. On the other hand, the distance of the nares and antorbital fenestrae from the center of the orbit, the backward extent of the cranium, etc., varies considerably from species to species.

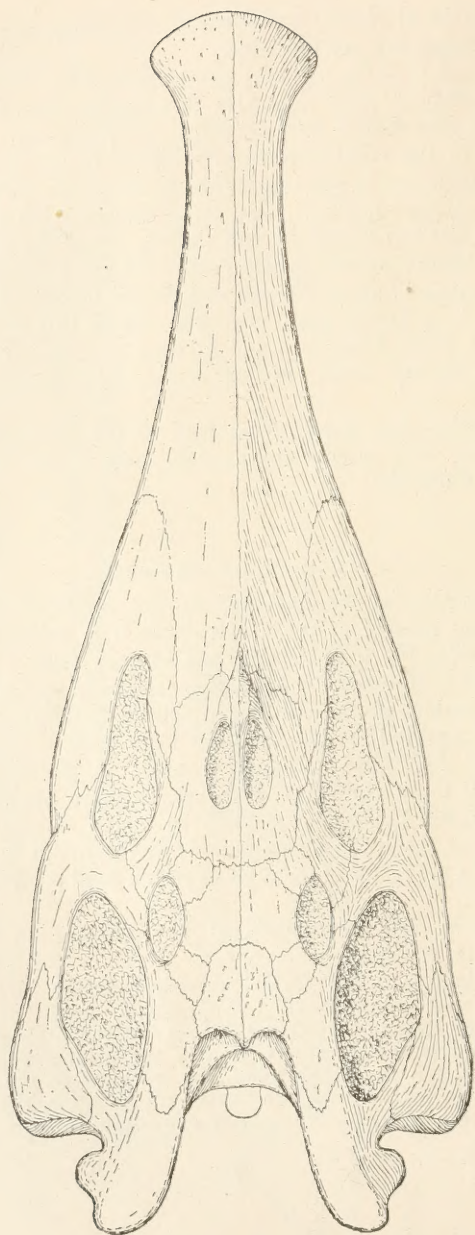


Fig. 2. *Muchaeroprotopus validus*, dorsal view of skull, about two-thirteenth natural size.

In the following paragraphs statements of the relative position of the nares, etc., refer to the distance from the center of the orbit.

In the position of the *nares* of the present form there is nothing of particular interest: the relative distance from the orbit is perhaps about the average of the later, that is, the more highly specialized phytosaurs. The anterior border of the nares is about 110 mm. in advance of the center of the orbit. The openings are about 70 mm. long and a little less than one-third as wide. They are separated by a thin vertical partition rising from the level of the posterior borders of the nares to a point some 30 mm. above their lateral borders anteriorly. In fact, the sudden elevation of the inner anterior border of the nares, together with the medium partition, form a well marked hump or rugosity that might be taken to suggest the presence of a nasal protuberance in life. This anterior elevation gives to the nares an upward and slightly backward direction whereas in all other known forms the nares are directed up and forward. The narial prominence as a whole rises somewhat above the general plane of the cranium proper, exceeding in elevation that of *Angistorhinus grandis*. (1)

The outline of the *orbit*, though somewhat flattened along the posterior side, is essentially round, about 70 mm. in diameter. The plane of the orbit is directed outward, somewhat less upward, and slightly forward.

The *antorbital fenestra* is oval in outline, 174 mm. long and averages 75 mm. in width though this latter measurement increases somewhat posteriorly. The long axis of the opening is directed slightly downward anteriorly.

The sides of the *lateral temporal fenestra* form a rough parallelogram with the greater and lesser diagonals 215 mm. and 150 mm. respectively. In a lateral view of the skull the lesser diagonal appears nearly vertical.

The *supratemporal fenestra* is similar to that of *Mystriosuchus*, that is, the posterior border is depressed. The opening is smaller than in *Mystriosuchus*, however, not only relatively but absolutely and is scarcely visible in a superior view. Of this more will be said later in connection with the posterior aspect.

(1) Jour. Geol., Vol. XXI, 1913, p. 187.

SEPARATE BONES OF THE DORSAL ASPECT.

While some of the sutures between the various elements of the dorsal surface are very evident, others are less distinct or even obscure. Anteriorly the *premaxillae* are broadly and rather suddenly expanded laterally to accommodate the large terminal teeth. The expanded portion is down curved at right angles to the rostrum and extends about 30 mm. below the plane of the palate. The union of the premaxilla with the maxilla is not certain, but seems to take the form of a sharp curve, convex forward. On the alveolar margin the union is in the region of the twenty-fifth tooth. The upper posterior process of each premaxilla extends to the anterior border of the nares.

The *septomaxilla*, if correctly determined, is exceptionally large. The union of this pair of elements at the anterior border of the nares forms the prominent swelling mentioned above and excludes the premaxillae from the narial opening. They are united for a distance of some 70 mm. in front of the nares and thence extend forward as sharp narrow processes a distance of about 40 mm., separated along the median line by similar processes from the premaxillae. The posterior extent of the septomaxillae along the inner walls of the nares is not certain, but they apparently make up a large portion of the dividing partition.

The *maxilla* is exceptionally large and forms the anterior half of the boundary of the antorbital fenestra. In most of the phytosaurs the maxillae have their greatest anterior extent along the alveolar margin, but in this specimen the sharply rounded anterior ends extend some 60 mm. beyond their union with the premaxillae at the lower border of the skull. Posteriorly the maxillae end abruptly in a sharp, downward projecting offset that forms a considerable notch in the lower border of the skull just back of the last tooth.

The *nasals* are sub-rectangular in shape and about twice as long as wide. They form the posterior, lateral, and nearly or quite all the anterior border of the nares. Anteriorly they extend but a comparatively short distance beyond the nares. Here each sends upward a process that extends about 20 mm. above the lateral borders of these opening to clasp the septomaxillary prominence. Posteriorly the nasals extend a very little beyond the posterior borders of the antorbital vacuities.

The *lachrymals* in shape, size, and extent are normally phytosaurian. They form the lower anterior border of the

orbit and the upper posterior half of the posterior border of the antorbital vacuities.

The *prefrontals* are small, quadrangular in shape, and form but a small part of the anterior border of the orbits.

The *frontals* are comparatively broad and short. Their extent along the median line of the skull is somewhat less than their combined width, the reverse of the condition usually found in the phytosaurs.

The *parietals*, too, are small and comparatively short along the median line. Unlike the condition in *Angistorhinus*, *Mystriosuchus*, *Palaeorhinus*, and other forms their combined width is less than the interorbital space.

The *postfrontals* are small and enter but slightly into the upper border of the orbits.

The *postorbitals* form the posterior borders of the orbits and a large part of the bar separating the orbit and the lateral temporal fenestra. The postorbitals have a considerable posterior extent and reach fully 50 mm. beyond the part of the parietals that lies in the dorsal plane of the skull.

The *jugals* form the lower posterior boundary of the antorbital vacuities and the anterior border of the lower temporal fenestrae. The superior process of the jugals forms the bar separating these two openings and apparently enters but slightly into the boundary of the orbit on the lower side.

The *quadratojugal* forms but a small part of the lower posterior boundary of the lateral temporal fenestra, and but little, about 40 mm., of the lower border of the skull. This latter is due not so much to its diminution in size as it is to the posterior extent of the jugals along the lower margin.

Seen from above the *squamosal* forms a long bar that projects backward and slightly outward, the pair forming a deep median notch in the upper posterior side of the skull. They form the posterior half of the upper border and almost the entire posterior border of the lateral temporal fenestrae. The posterior projection of the squamosal beyond the quadrate bears a stout inferior process that forms the posterior boundary of the ear notch.

POSTERIOR VIEW OF SKULL.

The posterior side of the skull resembles that of *Mystriosuchus planirostris* in outline most nearly, perhaps. It is about twice as wide as high and in this respect stands between *M.*

planirostris and *Lophoprotopus kaffi*, the former being higher, the latter broader proportionately.

The *supratemporal vacuities* are exceptionally long antero-posteriorly, measuring at least 120 mm. in that direction. They face chiefly inward, less upward, and slightly backward. They lie largely under the posterior extension of the squamosals in such a way that they are conspicuous neither in a direct superior view nor in a posterior view.

The *foramen magnum* is comparatively small, about 21 mm. in diameter.

The *quadrate foramen* has its normal position between the quadratojugal and the quadrate at a point about 80 mm. above the articular surface of the latter, considerably higher than in other known forms. Its vertical diameter is about 27 mm., its horizontal 17 mm., much greater than the corresponding measurements in the other described phytosaurs and compatible only with those of *Angistorhinus*.

The *post-temporal vacuities* have the usual proportions and relations found in the phytosaurs, but they are exceptionally large. While the upper border, the parieto-squamosal arcade, is partly broken away on either side of the skull, the lower and the median-lateral boundaries of the openings remain to indicate their size. They are approximately 50 mm. long and are apparently from 10 mm. to 15 mm. high. Their outer lateral boundaries are formed by the squamosals alone and not by the union of the opisthotic with the parieto-squamosal as in the case in *Mystriosuchus*, *Angistorhinus*, *Lophoprotopus*, and other forms.

BONES OF THE POSTERIOR SIDE OF THE SKULL.

While certain portions of the skull are broken away as indicated above, and while the sutures are not evident in all cases, with the aid of another specimen to be mentioned later, a fairly accurate idea of the relations of the various elements of the posterior side may be gained.

The *parietals* form the upper rim of, and extend down into the median, posteriorly directed concavity of the upper posterior surface of the skull. The union of the parietals with the squamosals is not determinable in as much as a goodly portion of the parieto-squamosal arcade is broken away. The dorsal posterior extension of the squamosal reaches some distance, approximately 84 mm. beyond the hindermost part of the quadrate. At about 53 mm. in front of the posterior end of the

squamosal it sends down the hook or projection mentioned above in connection with the dorsal aspect, a projection very similar to that of *Angistorhinus*. While the tip is broken from this process on either side of the skull it probably extended some 114 mm. below the general plane of the dorsal surface.

Von Heune, in his description of a specimen of *Belodon* (*Mystriosuchus*) *pleiningeri*, figures and describes the *epiotic* as forming a part of the median lateral boundary of the supratemporal fenestra visible on the posterior side of the skull and indicates that in all other known cases it forms a single unit with the supraoccipital (1). To quote:

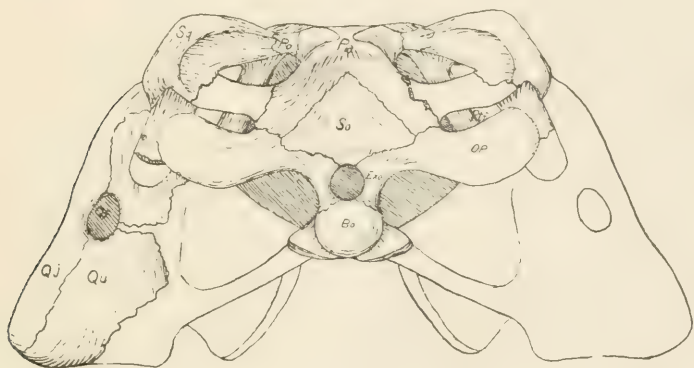


Fig. 3. *Machaeropsopus validus*, posterior view of skull, about seven-thirty-seconds natural size.

“Die Epiotica schliessen sich direct lateral an das Supraoccipitale an, mit dem sie ja in allen anderen sonst bekannten Fallen eine, einzige Knocheneinheit bilden. An der Hinterseite des Schaedels wird Epioticum medial vom Supraoccipitale, dorsal vom Parietale und Ventral vom Aufklaeufer des Squamosum begrenzt.”

This is a unique relationship for the epiotic and perhaps the apparent fusion with the supraoccipital in “all other known cases,” or in some of them at least, might be taken for an indication that this was not the true position of the epiotic.

(1) Beitrage Zur Kenntnis und Beurteilung Der Parasuchier, Geol. u. Pal. Abhandlungen, Neue Folge, Band X, Heft I. 1911, p. 22, fig. 3.

Certainly in the present specimen this element is not visible in a posterior view nor does it form a part of the border of the supratemporal fenestra. Its relations, which are quite different from those described by Von Heune, will be discussed further on.

The *supraoccipital* is a large, triangular bone. It forms a large part of the median concavity mentioned above, on the upper posterior surface of the skull. It also forms a small, but appreciable portion of the upper border of the foramen magnum. The exoccipitals form the sides and a goodly portion of the lower margin of this foramen. Their union with the opisthotics is complete. The opisthotic unites with the parietal on the inner side of the posttemporal fenestra to form the boundary of that opening as is commonly the case in the phytosaurs, but unlike the usual condition does not again unite with the parieto-squamosal arcade to form the outer boundary of the opening. Instead it extends directly horizontal and abuts against the inner surface of the squamosal hook. At their distal ends the opisthotics are expanded vertically, but are considerably compressed antero-posteriorly.

The *basioccipital* is considerably abraded, but is supposedly very similar to another specimen to be described later.

Unfortunately the lower inner corner of the left *quadrate* and the entire right one are missing as is the greater part of both *pterygoids*. It is seldom that the relation between the pterygoid and the quadrate has been accurately described. In most cases the union of these two elements on the posterior surface of the skull is indistinguishable. Von Heune has, however, worked this relationship out for *Belodon* (*Mystrisuchus*) *plieningeri* with the utmost care and has observed essentially the same conditions in other specimens including at least two of *Lophoprotopus* (*Phytosaurus*) *kapffi*. In brief, the pterygoid is described as a thin plate of bone overlying the quadrate, but not suturally united with it. The pterygoid completely covers the inner anterior extension of the quadrate on the median surface of the latter back to near the quadrate's inner condyle. Thence the pterygoid (its posterior border) extends up and out in an irregular step-like line to the upper side of the quadrate foramen which it borders above. From here the pterygoid extends outward in a point between the quadratojugal and the squamosal and is visible here on the lateral surface of the skull. Above it articulates with the outer end of the opisthotic and with the squamosal.

This lateral extension of the pterygoid over the quadrate in the region of the quadrate foramen and the union of the former with the quadratojugal on the lateral surface of the skull have not been noted in any of the North American specimens, possibly because most of them are more or less fragmental or poorly preserved. In *Angistorhinus* the relations of the quadrate and of the pterygoid had to be determined largely from casts, but its lateral extent on the posterior surface of the skull seemed to be slight and there was no indication that the pterygoid bounded the upper side of the quadrate foramen or articulated with the quadratojugal on the

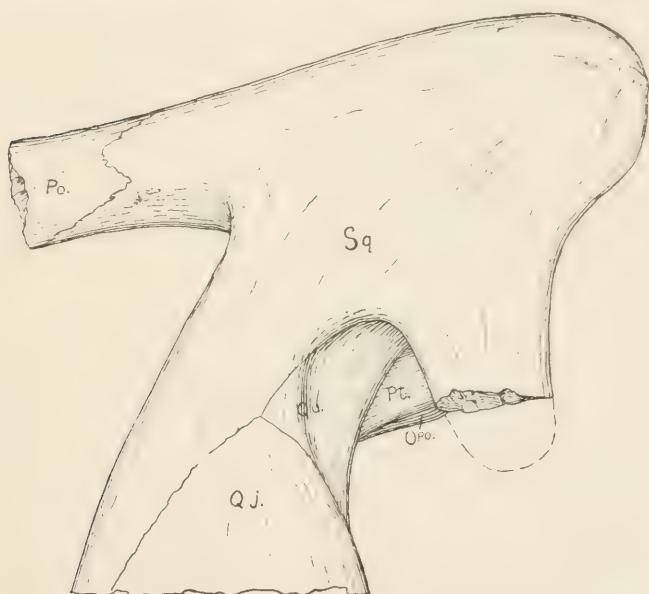


Fig. 4. *Machaerops validus*, lateral view showing details of squamosal-quadrate region, about one-half natural size.

lateral surface of the skull. While both pterygoids are largely broken away in the present specimen the quadrate end of the left one is preserved and shows its relation with the quadrate very well.

In a lateral view of the skull the pterygoid is visible

through the notch formed by the squamosal hook (see fig. 4) but it does not appear on the lateral surface of the skull. It is widely separated from the quadratojugal by the upper end of the quadrate which at this point bends around on the lateral surface and sends a sharp angular process between the squamosal and the quadratojugal.

The portion of the pterygoid that remains is in the form

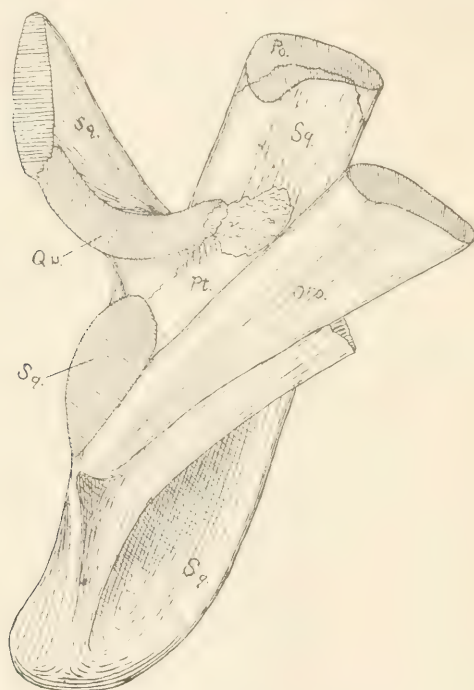


Fig. 5. *Machaeropsopus validus*, ventral view of squamosal region showing relations of squamosal, opisthotic, pterygoid and quadrate, three-fifths natural size.

of a narrow process that lies close against and parallel with the opisthotic on one side and in close contact with the upper end of the quadrate on the other as shown in figure 5. The outer end of this blade-like process abuts against the squamosal hook. In a ventral view the pterygoid appears to exclude the

quadrate from articulation with the opisthotic but the quadrate bends over the upper side of the pterygoid and joins the opisthotic with ample contact.

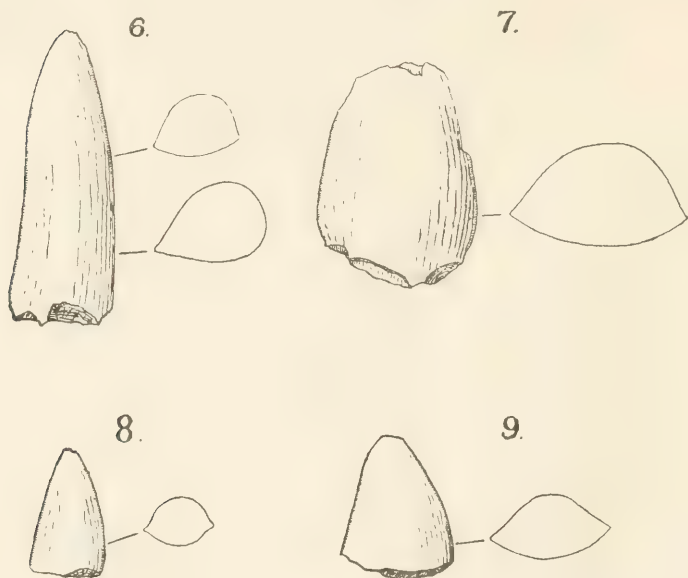
THE DENTITION.

As is commonly the case among the phytosaurs, the crowns of most of the teeth are missing, but the roots are for the most part well preserved and these with the few crowns present give a fairly accurate idea of the size, nature, and spacing of the teeth. As has been suggested (1), some of the phytosaurs combine in the dentition of a single individual a considerable variety in the size and shape of the teeth. The present specimen shows this variation exceptionally well.

In each premaxilla there are apparently twenty six or twenty seven teeth (the posterior extent of the premaxillae along the alveolar margin is not certain) and ten or eleven in each maxilla, a total of seventy four teeth in the upper jaw. This is a smaller number than is found in any of the other phytosaurs except *Palaeorhinus* and perhaps *Mesorhinus*, notwithstanding the fact that the alveolar margin is longer than in any other form yet described. All of the teeth of the premaxillary terminal expansion are missing, but their outer alveolar margin indicates their size. There are three teeth of large size on either side, perhaps as much as 18 mm. in diameter at the base. While the length of these terminal teeth suggested in the accompanying illustration, about 75 mm., is more or less hypothetical, it is no greater than in the corresponding teeth in *Angistorhinus*. Indeed, a shorter crown would produce a more or less blunt cone out of keeping with the rest of the dentation and not well adapted for the use to which they were probably put. Of these terminal teeth the median ones were directed downward and perhaps slightly backward, the outer two on each side were directed downward and considerably sidewise. The teeth that immediately follow the terminal expansion are smaller, round in section at the base, about 12 mm. in diameter. The first three on either side are in advance of the terminal teeth of the lower jaw and are directed somewhat laterally. The next three are directed downward and evidently close within the terminal teeth of the mandible. The following teeth again turn more or less outward.

(1) Mehl, Loc. Cit., P. 150.

There is apparently no distinction between the premaxillary and the maxillary teeth, but rather a gradual transition both in the size and shape of the crowns. In cross-section the roots range between 11 mm. and 20 mm. in diameter, the larger ones being the most posterior in general. The crowns of the anterior teeth are sharply conical and slightly incurved. They bear a rather sharp anterior and posterior, finely serrate cutting edge that divides the crown into a more or less flattened inner surface and a strongly convex (from side to



Figs. 6-9. Phytosaur teeth, presumably from the genus *Machacroprosopus*. Fig. 6, from terminal expansion of the lower jaw? Fig. 7, laterally compressed tooth near the posterior end of the upper series. Figs. 8 and 9, intermediate teeth of the upper series. All figures a little less than natural size.

side) outer surface. Posteriorly the crowns become laterally compressed and have a much greater antero-posterior diameter. One of the crowns of the maxillary series, probably about the seventh from the rear, was preserved in the loose matrix. Much of the enamel has been exfoliated, but the

remains indicate a tooth very similar in size and shape to that shown in figure 7. The lateral compression of the posterior teeth is not confined to the crown alone; some of the roots, too, are markedly flattened.

The teeth are crowded close together, for the most part. Toward the posterior end of the series and even well forward where the teeth are comparatively small, the alveoli are in several cases apparently confluent and but rarely are they separated by a space of more than 2 mm. or 3 mm.

THE PALATE.

Little can be said of the palate; the portion back of the anterior edge of the antorbital fenestrae has been crushed and broken and preserved only in fine fragments. Apparently the rounded longitudinal ridges that bound the alveoli on the inner side in *Mystriosuchus*, *Angistorhinus*, and other forms are lacking in the specimen under discussion; at least they are in no wise conspicuous. The palate surface of the rostrum is rounded from side to side, convex downward, a condition that would answer the same purpose, vis., a buffer for the jaws when they are forcibly snapped together.

THE MANDIBLE.

The mandible is exceptionally massive. Its tip is considerably expanded laterally to accomodate the large terminal teeth. The swelling of the tip below is very slight, however. The width of the expansion is approximately 120 mm., the thickness 65 mm. The measurements immediately back of the expansion are 70 mm. and 57 mm. respectively. At the posterior end of the symphysis the vertical measurement is about 80 mm. and the width 140 mm. The symphysis is relatively short; the total length of the mandible is 930 mm. while the symphysis is but 360 long. In the type of *Angistorhinus* with a mandible the same length as that of the present form the symphysis is 430 mm. long.

The tip of the mandible is marked by small deep pits, apparently the surface expression of small foramina, spaced about 10 mm. apart. Back of the expansion these pits extend posteriorly in a linear arrangement at the bottom of two narrow, well defined grooves roughly parallel with the alveolar margin. One of these grooves extends from the expansion to a short distance in front of the external mandibular foramen where the groove is 35 mm. below the alveolar margin. The second,

less distinct, more nearly parallels the lower edge of the mandible. The outer face of the mandible back of the external mandibular foramen and below the surangular ridge is marked by prominent, irregular ridges so arranged as to form large irregular depressions.

The external mandibular foramen is exceptionally long and narrow with the upper and lower borders nearly parallel throughout. In length the opening measures 280 mm. The upper border is continued posteriorly nearly to the posterior end of the ramus in a horizontal ridge or shelf, the surangular ridge, on the outer surface of the mandible. The internal mandibular foramen is 120 mm. long and apparently about 30 mm. wide (the upper border is broken away). The posterior boundary lies some 20 mm. back of that of the external mandibular foramen.

THE TEETH.

In each ramus there are thirty-nine or forty teeth. In the terminal expansion there are three large teeth, the first 15 mm., the next two subequal teeth 22 mm. in diameter at the base. Anteriorly between the teeth of the two rami is a space of 27 mm. The crowns of these terminal teeth are apparently flattened on the inner side as is evidence by the flattening of the inner side of the roots.

The following teeth are all broken off, but nearly all of the roots remain and serve to give an idea of the size, shape, and spacing. The teeth immediately following the terminal expansion are all considerably smaller than the corresponding teeth of the upper jaw, the first six being but little over 5 mm. in diameter. From this point to about the twenty-third tooth they average perhaps 9 mm. in diameter. All of the smaller anterior teeth are round in section and crowded close together. In most cases there is really no interalveolar space and rarely is the space over 2 mm. The first tooth back of the expanded tip is separated from the third large terminal tooth by a space of 4 mm.

From the twenty-third tooth back they rapidly increase in size, especially the antero-posterior dimension, and even the roots show a marked tendency to a lateral compression. The root of the fourth from the last, for instance, measures 21 mm. in an antero-posterior direction and 18 mm. across. The large posterior teeth like the smaller anterior ones are closely crowded with an inter-alveolar space of but 2 mm. to 4 mm. The

linear ridges that usually border the alveoli on the inner side are missing. The space between the two tooth rows is strongly arched from side to side, rising at least 10 mm. or 12 mm. above the lateral alveolar margin.

One of the striking features of the form under discussion is the extension of the rostrum beyond the tip of the mandible a distance of nearly 100 mm. Had the jaws and skull not been so intimately associated in the matrix one might well have taken them to belong to two individuals, or possibly to different species. Clearly the difference in length of the upper and lower jaws is for the accommodation of the large terminal teeth in each. Were the two of the same length they could not have been closed because the terminal teeth are too closely spaced to allow interlocking. The retreat of the mandible, however, allows the lower terminal teeth to close on either side of the rostrum back of its expanded portion.

RELATIONSHIPS AND HABITS.

There can be no question of the close relationship of the present form with that described by Cope from New Mexico under the name of *Belodon buceros* (1). The two specimens apparently represent distinct species, however. The posterior border of the nares in Cope's type is more anterior, and the antorbital vacuity has less antero-posterior extent and lies somewhat further back than in the present form. In the latter specimen, also the anterior border of the nares is complete and much higher than the posterior border, the opposite of the condition in the former. The difference in the contour of the rostral crest is also probably too great to be considered an individual variation.

What appears to be a phytosaur of large size was described some time ago by F. A. Lucas under the title "*Heterodontosuchus ganei*, A New Crocodile from the Trias of Southern Utah" (2). The material consists of "The imperfect anterior portion of the lower mandible of a crocodile comparable in size with *Tomistoma* among living and *Thoranosaurus* among the extinct species." To quote in part:

"The genus is characterized by the antero-posterior com-

(1) Am. Nat., Vol. IV, pp. 922-923, 1881.

(2) Am. Jour. Sci., Vol. 156, 1898, p. 399.

pression of the teeth, the closeness to one another, and by the great size of the two anterior teeth."

McGregor suggests the possibility of this being identical with Cope's "*Belodon buceros*." (1)

While the specimen from Arizona described above agrees with *H. ganei* in the closely crowded anterior teeth, the two forms differ in many other respects as indicated in the following table:

<i>H. ganei</i>	Arizona Specimen
Symphysis long	Symphysis short
Two large terminal teeth	Three large terminal teeth
Terminal teeth round in section	Terminal teeth flattened on the inner side.
Teeth immediately back of terminal expansion antero-posteriorly compressed	Teeth immediately back of terminal expansion round in section.

Some time ago Jaekel, in an article describing a new phytosaur, called attention to the differences between the American crested form of Cope and the European *Lophoprosopus* (*Phytosaurus*) *kapffi* and considered Cope's type generically distinct (2). To quote:

"Durch die Gesamtform des Schaedels, besonders die Vorwölbung des praenasalen Schnauzenteils, die weit rüekwaertige Lage des Nasen und die weit Vorstreckung der Squamosa-Ecke ist die Form in Rahmen der Phytosauridae so deutlich gekennzeichnet, dass ich für sie daraufhin einen neuen Gattungstypus vorschlagen, und ihm den Namen *Metarhinus* geben mochte. Er ist basiert auf den *Belodon buceros* Cope aus der Trias von New Mexico."

The writer, too, is inclined to consider this form as generically distinct from the European crested form. The rostral crests are of distinct types, sharp edged and high and ending a considerable distance back of the tip in the American form, depressed and swollen in the European form and reaching near the tip of the rostrum. The development and articulation of the posterior end of the pterygoid in *Lophoprosopus kapffi* as noted by Von Huene is also in marked contrast with the con-

(1) Memoirs Am. Mus. Nat. Hist., Vol. 9, Part 2, 1906, p. 91.

(2) Sitzungsberichten Der Gesellschaft Naturforschender Freunde, No. 5, Jahrgang 1910, p. 219.

dition in the American crested form as pointed out above, at least in the case of the specimen herein described (the condition of Cope's type has not been determined but is probably the same). Perhaps one of the most weighty considerations is that of the known distribution of Triassic genera of vertebrates. So far as the writer can learn, there is not a single Triassic genus that is, without a reasonable doubt, recorded from both Europe and North America. It seems reasonable to suppose that the crested phytosaurs of the two continents are but parallel developments as are the forms with the slender rostrum, *Angistorhinus* and *Myriosuchus*.

Unfortunately the name proposed by Jaekel, *Metarhinus*, is not available (1) and the writer would suggest the name *Machacroprosopus*. Of this genus *M. validus*, the form herein described, may be the type. *M. buceros* is the second species of the genus.

All of the phytosaurs were supposedly more or less amphibious in habit. Still, the heavy dermal armor of several of the forms would indicate that a very considerable part of their time was spent on the land. The posterior position of the nares is usually not considered a distinct aquatic adaptation in the case of the phytosaurs. It is rather explained, along with the long snout and large terminal teeth, by attributing to the slender rostrum the function of a prod or rake with which the possessor searched out worms and other soft bodied invertebrates, etc., in the mud of shallow waters while the nares, by virtue of their position, were above the surface of the water.

There is a marked tendency in most of the phytosaurs, a tendency in which *M. validus* surpasses all other known forms, for the nares to rise on a considerable prominence. This would seem to be a modification entirely uncalled for were the position of the nares due solely to the use of the rostrum as a prod. So situated are the nares in *M. validus* that it could submerge the body save for the narial hump and lie in wait admirably concealed from its enemies, or more likely, from its prey. Certainly the teeth of this form are more fitted for tearing large vertebrates than for small, mud-burrowing creatures. Then, too, *Machacroprosopus* could scarcely pick small objects from the ground because of the difference in length between the up-

(1) Osborn gave this name to a genus of Eocene mammals in 1908 (Bull. Am. Mus., Vol. 24, 1908, p. 609).

per and lower jaws. When the jaws are closed the terminal teeth of the lower jaw are functionless and the upper terminal teeth are but little better. It is not till the jaws are wide open that the terminal teeth could be used effectively either as a rake or for seizing any sort of prey. With the jaws separated, however, the upper and lower terminal teeth are directly opposed and admirably fitted for seizing and tearing large animals. It seems likely that *M. validus* was wont to lie in wait concealed close up to the shore in shallow waters ready to seize its prey when the latter came down to drink. Once the prey was dragged into the water it was at the mercy of the captor for the dentition of the latter probably matched that of any carnivorous land form of that time and the phytosaur had the distinct advantage of being entirely at ease in the water.

Machaeorprosopus Sp.

Among the phytosaur remains in the University of Wisconsin collections two other specimens, No. 3808 U. W. and No. 3809 U. W. are of more or less interest because of their apparent close relationship with the form described above. Both of the former are in a very fragmentary condition and consist of the upper posterior part of the skull only. The two specimens are very similar in size and general proportions and differ only in minor points such as markings, etc. While they are considerably smaller than the type of *M. validus* and have somewhat different proportions and markings, all three probably belong to the same species, the two smaller specimens being young individuals. They serve, perhaps to show the importance of individual variation.

Specimen No. 3808 is of especial interest in that it shows the relations of the epiotic and the prootic and other features not well shown in the type of *M. validus*.

The epiotic is about 45 mm. long and somewhat over three times as long as wide. It is directed upward and forward from its union with the supraoccipital. The latter shows as a small triangle between the parietal, prootic, and epiotic. The upper end of the epiotic is bent at right angles to the long axis of the skull and fits into a shallow concavity formed at the union of the parietal and postorbital. The squamosal at no place comes in contact with the epiotic nor does this latter element appear on the posterior surface of the skull. It is bounded above slightly by the postorbital, on the upper posterior side by the

parietal, posteriorly by the supraoccipital, and below by the prootic.

The prootic is 70 mm. long, about twice as long as wide and directed antero-posteriorly. It is united posteriorly with the opisthotic through a long, splintery suture. Above it articulates with the parietal, supraoccipital and epiotic. The nature of the union with the basisphenoid cannot be determined as the lower anterior portion of the prootic is broken away. Fractures through the lower posterior part of the bone disclose



Fig. 10. *Machuerosopus* sp., lateral view showing details of epiotic-prootic region, postorbital bar cut away, somewhat under natural size.

what appears to be two circular canals entirely confined to this element, one in a vertical plane parallel with the axis of the skull, the other in a horizontal plane.

The pterygoid processes of the basisphenoid are very prominent and more distinctly set off than in either *Angistorhinus* or *Lophoprosopus*. On the inner side of each is a small but

pronounced conical tubercle. The greater wings of the basisphenoid are widely expanded in a lateral direction but do not extend downward any considerable distance below the occipital condyle. These wings are separated along the medium line of the basisphenoid by a shallow but sharp concavity into which the anterior process of the basioccipital extends. The condyle is distinctly set off by the neck-like constriction of the basioccipital. In general the basioccipital and basisphenoid resemble *Parasuchus hislopi* most nearly perhaps. Figure 10 will show the distinctive features of *Machacroprosopus*, however.

Angistorhinus? Sp.

About half a mile away from the type specimen of *Machacroprosopus* described above and at approximately the same horizon was found the right ramus of an extremely slender jaw, No. 3810 U. W. The following is a table of the more important measurements:

Total length of ramus at least	810 mm.
Length of symphysis	355 mm.
Width of terminal expansion	60 mm.
Width immediately back of terminal expansion	33 mm.
Depth of jaw immediately back of terminal expansion	44 mm.
Depth at posterior end of symphysis	50 mm.
Width of ramus at posterior end of symphysis	60 mm.

Of the dentition but little can be said save for the number and spacing of the teeth. But a single tooth, number 33 (from the tip) is preserved. Of this only the tip of the crown projects from the alveolus, but a fracture in this region exposed the entire tooth. It is very much compressed laterally with sharp, finely serrate anterior and posterior edges. The crown is about 9 mm. in an antero-posterior measurement, less than 5 mm. thick, and about 14 mm. high.

In the expanded tip of the ramus there are three alveoli, all considerably larger than those that immediately follow. The first is broken but has the indications of being comparable in size with the second. This is round, about 10 mm. in diameter, and directed considerably forward and somewhat less outward. This third alveolus, the largest of the three, is directed somewhat outward, but not forward.

The following six alveoli are considerably smaller and are slightly longer (antero-posteriorly) than wide, these measurements averaging about 5.5 mm. and 4 mm. respectively. The first of this series is separated from the large anterior set by



Fig. 11. *Angistorhinus*? sp. lateral view of mandible, somewhat under two-ninths natural size.

a space of 5 mm. From the tenth to the nineteenth the alveoli are all round in section and from 7 mm. to 9 mm. in diameter, progressing regularly in size toward the rear. This series assumes an upright position as compared to the lateral trend of the smaller anterior teeth. From number nineteen the alveoli take on a laterally compressed shape and increase to 13 mm. or 14 mm. in an antero-posterior measurement. Posteriorly these large compressed alveoli are closely crowded and are actually confluent from the thirty-third back. The slight filling between the teeth apparently consists of a spongy mass of bone that is not a part of the dentary. In reality the teeth are planted in a groove the walls of which are perfectly smooth. The exact number of alveoli is not certain, but forty-two are distinct and there is a possibility of one or two more.

While this specimen does not agree in several detail with the described specimens of *Angistorhinus*, its slender build and great length are more indicative of that genus than of any other form from the Western Trias of North America.

Machacroprosopus? Sp.

In the University of Chicago material collected near Holbrook, Arizona, is a right ilium of a phytosaur of large size, No. 1252 U. of C. In all essentials it resembles that of *Rhytidodon Carolinensis* figured by McGregor (1).

The supra-acetabular ridge is less prominent in the former, however, and the proportions are somewhat different. The upper posterior extent is greater as is the vertical measurement in the present specimen and it is apparently more massive throughout. The large size suggest its possible position in the genus *Machacroprosopus*.

(1) Loc. Cit., Pl. X, fig. 41.

THE TRIASSIC FOSSIL BEARING HORIZONS NEAR WINGATE, NEW MEXICO.

With a Description of

Acompsosaurus Wingatensis, Mehl.

M. G. Mehl and G. M. Schwartz.

The University of Wisconsin paleontological expedition of 1914 spent some time in New Mexico collecting vertebrate remains in the Triassic rocks about Fort Wingate, an abandoned army post about ten miles east of Gallup and a short distance south of Wingate station on the Santa Fe railroad.

The region lies on the northwest end of the Zuni uplift. (1) and the strata dip regularly to the north at an angle of from 5 degrees to 7 degrees. In following the exposures from south-east of the fort directly north across the Santa Fe tracks a distance of five miles, a more or less continuous section is to be observed from the oldest Triassic probably up into the Cretaceous. The lowest beds examined (Plate 1, Sec. 1, Div. 1) consist of hard, compact, blue-gray clays with vertical variations in color that give a distinctly banded appearance. Gypsum nodules are more or less conspicuous, especially in the lower horizons. Bone fragments are sparsely scattered throughout these clays, most abundantly near the base. None of the fragments collected are determinable, however, though some suggest strongly the phytosaur remains so abundant in the formation that immediately follows. Although the base was not exposed in the locality investigated it is supposed that the clays are of Triassic age because of the suggestion offered by the bone fragment and the apparent continuity of the beds with the overlying series which is certainly Triassic. A com-

(1) Darton, N. H., Reconnaissance of Northwestern New Mexico and Northern Arizona, U. S. Geol. Survey, Bull. 435, p. 44.

parison with Gilbert's section would tend to place the first division well down near the base of the Triassic section.

These blue clays outcrop in wide bad-land pockets to the southeast of the old fort.

Above these bluish clays is a red series (No. 2 of the above section) of at least 150 feet, consisting predominantly of unbedded, rather soft, red clays although considerable thicknesses of arenaceous shales are abundant throughout. These arenaceous shales are often more or less cross-bedded and ripple-marked, are abundantly specked by minute mica flakes and are always more or less calcareous. Some twenty to forty feet from the top of this division occurs a well marked conglomeritic horizon consisting of more or less continuous bands and lenses. The conglomerate in its typical expression consists of small irregular calcite and clay pebbles averaging in size perhaps that of a pea, with a matrix of highly calcareous red clay. Calcite concretions of several distinct types are rather conspicuous throughout this red unit, notably in the upper half of the series. Each type is apparently characteristic of certain beds though not necessarily confined to a particular horizon. One of the most common is of a flattened form, round in outline and averaging perhaps three inches in diameter. Others are spherical in shape and are half an inch or less in diameter. Still others are very irregular in outline and resemble in general small bunches of grapes from 1 to 2 or even 3 inches in length.

Succeeding these red beds is a very persistent blue-gray, very fine, highly calcareous sandstone, occurring in thin lenses interstratified with red clays, more rarely confined to a definite bed. Contrary to what one would expect considering the abundance of iron in both the overlying and underlying beds, this sandstone apparently contains no traces of iron. Other than worm borings fossils are rare although at least one specimen of vertebrate remains was collected from this horizon.

Above this sandstone lies a peculiar mottled purple and white unbedded clay that outcrops in bad-land slopes, is very hard on an unweathered surface, but readily breaks down to a fine powder. The mass is dull purple, a color imparted to it by ferric iron and a small amount of manganese. The mottling consists of white spots, for the most part under half an inch in diameter, roughly spherical in shape, and rather regularly distributed throughout, thus giving the entire mass the ap-

pearance of a weathered amygdaloid. The entire bed, of one hundred feet at least, is shattered by innumerable fractures with slickenside surfaces which run in all directions except horizontal and meet each other at all angles. Inasmuch as this is the only bed thus affected it seems unlikely that the fracturing is due solely to the tilting of the Zuni uplift, but that the explanation must be sought for in the materials of the bed itself. The fact that the deposit is nearly pure kaolin, and that original transported deposits of this nature are extremely rare, would make it seem more likely that the clay is a result of the alteration of more complex silicates, etc. The resulting volume changes, acting with gravity and the weight of the overlying beds, could well account for the small amount of movement which caused the fractures and slickensides. That the movement was very slight is evidenced by the small displacement noted wherever the fracture cross the vertebrate remains occasionally found.

A careful study of the rock has brought out some interesting data on the origin of the mottling. There is no apparent relation of the white spots to structural features, but the strongest evidence points to the conditions of sedimentation as being the controlling force of the distribution. In the center of the uncolored portions is almost invariably found a small black fragment of carbonaceous matter. These particles are usually under 3 mm. in diameter but are rarely much larger. Inasmuch as there are no traces of iron or manganese in the white spots it seems probable that the carbon has been active in reducing the iron and manganese to a more soluble form and in consequence these have been leached out. This is further evidenced by the fact that the clay immediately surrounding bone fragments is also free from iron and manganese and that the uncolored portion surrounding the black specks are in size roughly proportional to the size of the black center. Microscopic examination of the carbonaceous centers has failed to show evidence of organic structure but one is probably safe in presuming that they are of vegetable origin. Just what the conditions were that disseminated this carbonaceous matter throughout the bed without any evidence of concentration along definite lines is not evident. It is a condition apparently limited to this bed for at least it has not been noted at any other horizon. As indicated above, remains of vertebrates are scattered sparse-

ly throughout, but these consist for the most part of fragments.

A course grained, light yellow sandstone follows that contains much fossil wood. The base is usually a well marked conglomerate of rounded and subangular siliceous pebbles and some clay nodules in a quartzitic matrix. No vertebrates have been recorded, but near the top a conspicuous layer of pelecypods occurs, too poorly preserved, however, for identification.

Northward this sandstone dips under the broad flat of the Puerco River and for a distance of possibly three miles there are no outcrops save a limited exposure of fine grayish to purple sandstone along the stream channel. This unexposed interval represents a series of beds close to 1000 feet in thickness in which the predominance of red shales is indicated by the residuum, residuum.

North of the Santa Fe tracks and roughly parallel is a line of high bluffs at the base of which appears a purple to green cherty limestone about thirty feet in thickness (Number 9 of section 1). Above this and separated from the limestone by a ten foot bed of calcareous red clay, rises a series of heavy-bedded sandstones, for the most part of a light brownish red color. The lower four hundred feet is uniformly bright brownish red and apparently makes up a single stratigraphic unit. This unit most certainly comprises a large portion of Dutton's Wingate Sandstone (1) and probably is its exact equivalent. The section here extends considerably above this but only the next 250 feet (Divisions 12 to 16) were observed with any degree of accuracy. This portion consists of extremely variable sandstones, for the most part massive bedded and varying in color from gray to red, pink and even buff. These beds in much probability correspond to the lower portion of the Zuni sandstone. (2).

In plate I a graphical comparison has been made between the section given above and that given by G. K. Gilbert from essentially the same point, viz, from Bear Spring, near Fort Wingate, to a point eight miles northward. (3) The major feature of these sections correspond well; in each a thick shale

(1) Dutton, C. E., Mount Taylor and the Zuni Plateau, 6th Ann. Rept., U. S. Geol. Survey, 1885, pp. 136.

(2) Loc. cit., p. 137.

(3) Gilbert, G. K., Rept. U. S. Geol. Survey, West of 100th Meridian, Vol. 3, 1875, p. 551.

series of approximately 1000 feet separated from a sandstone series above by an apparently continuous limestone bed, (divisions 9 and 12, section 1 and 2 respectively). In the minor features of the two sections, however, the correlation is extremely difficult. This is to be expected when one considers the extreme lateral variation of the beds in a very limited distance. For instance, division 5 in the first column, a very conspicuous layer about Fort Wingate, finds no certain equivalent in the section given by Gilbert although division 8 may be the corresponding bed. The correlations indicated by the dotted lines between the two sections here given should be taken as merely suggestive and are in no wise based on definite knowledge.

Fossils consisting of indeterminate bone fragments have been noted by Darton in the shales underlying the Wingate sandstone, (1) in all probability bed No. 10 of the section herein described. No fossils were found at this horizon by the Wisconsin party, nor, indeed, at any horizon above the lower 450 feet of the section examined. This is doubtless due to the fact that prospecting was largely confined to the lower and more prolific horizons.

As indicated above, the red shale series, (unit No. 2, section No. 1), is by far the most highly fossiliferous. In a preliminary notice of the results of the University of Wisconsin paleontological expedition of 1914, the senior author mentioned a new form, *Acompsosaurus Wingatensis*, from the Wingate region (2). This specimen has been prepared for mounting by the junior author and now permits a full description.

Acompsosaurus Wingatensis, Mehl.

The material upon which this form is based, No. 3811 U. W., consists of a nearly complete pelvic girdle and numerous fragments including parts of vertebrae centra, small pieces of ribs, many thin irregular plates, presumably dermal scutes, a few phalanges, etc. The pelvis has been somewhat distorted, however, the essential features are readily determined. The left pubic bone has been broken and telescoped at its acetabular portion in such a manner that the posterior part overrides the

(1) Loc. cit., p. 46.

(2) Mehl, M. G., New Reptiles from the Trias of Arizona and New Mexico. Science, N. S., Vol. 41, May 14, 1915, p. 735.

ilium. The left ilium has been crushed in and back and the centra of the vertebrae are pushed somewhat to the right. The left side of the pelvis is practically complete except for a small portion of the posterior edge of the pubis along the lower border of the acetabulum and a section of the posterior border of the ilium. On the right side the pubis is missing as is the acetabular portion of the ilium and a considerable part of the upper posterior border of the ilium. The sacral ribs and verte-

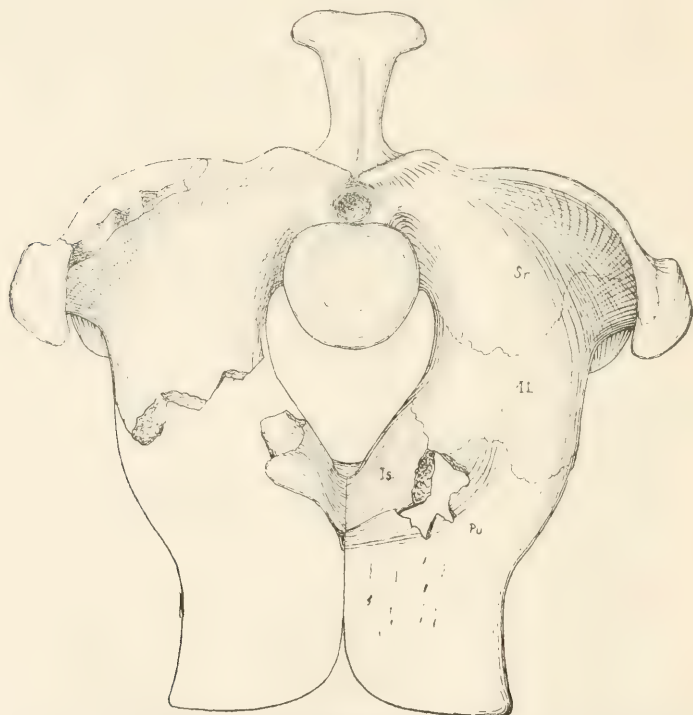


Fig. 12. *Acompsosaurus Wingatensis*, anterior view of pelvic girdle, a little under one-fourth natural size.

brae are practically complete. The entire specimen was covered with a thin but extremely hard concretionary coating. The bone is hard, however, and permits the rough treatment necessary for the removal of the matrix.

The pelvis as a whole is strikingly massive and compact.

The total height of the girdle measured from the top of the spines to the lower projection of the pubis is 450 mm. The width measured from the outer borders of the illia is 370 mm. The greatest antero-posterior measurement allowing for a small portion missing from the posterior end of the ilium is estimated at 280 mm. The pelvic opening is comparatively small although wide and flaring at the front. Posteriorly it has a marked lateral constriction, possibly due to some extent to the distortion of the specimen although this is not evident. In this region the opening is "V" shaped with a comparatively sharp apex below. The greatest width of the opening posteriorly, at the level of the lower margin of the centrum of the sacral vertebra, is about 100 mm. The vertical measurement below the posterior edge of the last vertebra is 85 mm.

The acetabulum is exceptionally large and deep. It is slightly oval in outline, about 80 mm. in its greatest diameter which is nearly vertical and 70 mm. in its lesser, the horizontal diameter. The sharply raised border of the articular surface forms a continuous circle except for a break made by a depressed notch in the lower border. The sides of this depressed area are set off distinctly and are directed upward along the pubo-ischiatic union. From the plane of its border the acetabulum has a concavity of approximately 47 mm. The articular surface is directed out and back and slightly down.

The sacrum consists of two closely united, robust vertebrae. The centra are spool-shaped with greatly expanded anterior and posterior faces. The expansion of the face is chiefly downward, especially the posterior face of the second vertebra. These faces are approximately round in outline and moderately concave. In diameter they are about 75 mm. The diameter of the constricted portion of the centrum is about 50 mm. The two centra are of the same length, 65 mm. The neural arch is strong and heavy and is pierced by a comparatively small neural canal approximately 18 mm. in diameter. The zygopophyses are quite broad with flat articular surfaces. The anterior pair of the first vertebra are directed upward and inward and slightly forward. The posterior pair of the second vertebra face downward, outward and somewhat back. The spines are heavy with wide transverse expansions above. The first spine is about 85 mm. in an antero-posterior direction and are about 30 mm. thick. The terminal expansions are somewhat constricted antero-posteriorly along the median line and measure a trifle

less in that region than the spine proper. The expansion of the first spine is 85 mm. by 57 mm., the second 51 mm. by 67 mm., the greatest dimension in each case being the lateral measurement. The surface of both expansions is slightly depressed along the median line. The close union of the short, stout diapophyses with the sacral ribs is apparently marked by a



Fig. 13. *Acompsosaurus Wingatensis*, left lateral view of pelvic girdle, a little under one-fourth natural size.

slight swelling. In the first vertebra this is some 30 mm. from the base of the spine and in the second it is about 18 mm. distant. The diapophysis has a broad attachment with both the centrum and arch. The sacral ribs are strong and massive. The first is greatly expanded antero-posteriorly at the distal

end and here measures 112 mm. in width. It has a length of 133 mm. The second rib has the outer posterior edge missing but probably has a length of about 115 mm. and a width of about 80 mm. at its distal expansion. The ribs are considerably thickened by a linear swelling on the under surface. This swelling apparently extends down along the inner face of the ilium some distance making a strong, almost indistinguishable union with that element. In general shape the ilium takes the form of three intersecting planes. Two of the planes are vertical, one parallel and the other at right angles to the vertebral column. These two planes make up nearly half of the acetabular surface, the upper anterior portion. The laterally directed plane or expansion is considerably thickened to accommodate the deep concavity of the acetabulum. At right angles to the vertical planes and resting on them is the third, a broad thick expansion some 130 mm. at the greatest width and extending laterally beyond the lower planes of the ilium about 50 mm. In an antero-posterior direction this horizontal plane measures about 190 mm. It is down-curved at both the anterior and posterior ends. The union with the pubis and ischium is broad and close and scarcely distinguishable. Although large, the pubis forms a comparatively small portion of the pelvic floor as the lower anterior part is broadly expanded in a thin plate-like form and bent abruptly down at right angles to the vertebral column. The upper anterior portion is considerably thickened at the union with the ilium. The lower outer corner of the expanded portion is swollen into an expanded foot-like form. The union of the pubis with the ischium was apparently cartilagenous as was the union of the pubes with each other. A small portion of the pubis is missing along the union with the ischium. It is likely that this missing part was pierced by a small foramen for the bone in this region thins rapidly towards the edge. If present the foramen was in much probability confined to the pubis. In outline the ischium is more or less triangular one side of the triangle forming the union with the pubis. The two ischia are united along the median line in a firm union the anterior half of which is produced into a thin sharp keel extending some 50 mm. below the lower border of the acetabulum. Posteriorly they form a flat, narrow, horizontal projection. The anterior half of the union, however, forms a forward pitching trough sharply convex upward. Allowing for a small portion missing from the pos-

terior end, the length of the ischia along the median line is 210 mm.

Little can be said of the associated scutes. Several rib fragments had adhering to them thin, smooth, irregular plates of bone separated by a thin film of matrix only. In the wash were a goodly number of such fragments of plates and a large number of somewhat thicker fragments with coarsely pitted surface. None of the pieces, however, show evidence of a keel or spine such as is present on the dorsal scute of most of the *Phytosaurs*. The greatly expanded spine terminations suggest an exceptionally heavy dorsal armor represented in the

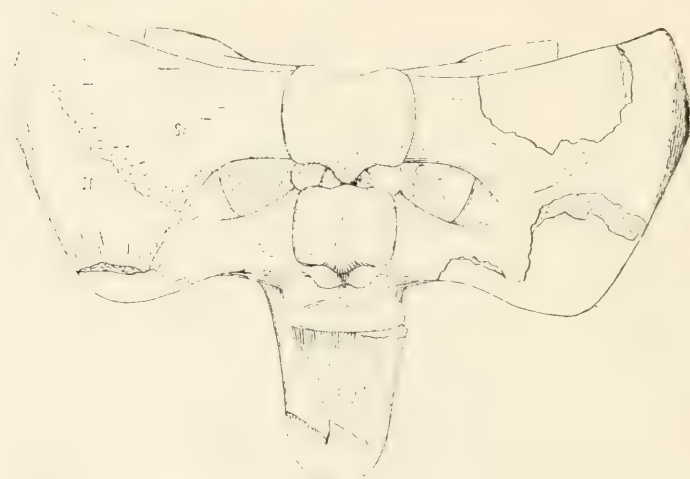


Fig. 14. *Acompsosaurus Wingatensis*, superior view of pelvic girdle, a little under one-fourth natural size.

collection, by the thick, pitted, plate-like fragments, perhaps. The thin plates with the smooth surface, so intimately associated with the ribs may represent a dorsal armor such as is found in some of the Permian *Cotylosaurs*, as, for instance, in *Diadectes*. (1)

That *Acompsosaurus* was a creature of considerable weight and that this weight was largely supported by the hind legs is

(1) Case, E. C., A Revision of the *Cotylosauria*, Carnegie Inst. Wash., Publ. No. 145, 1911, p. 78.

evidenced by the massive build of the pelvic girdle. The large deep acetabulum with the articular face directed considerably back and the firm union of the illia with the broadly expanded sacral ribs suggest strongly a bipedal gait. An accompanying squatting posture on the haunches, the weight being borne in part at least by the pubis is evidenced by the marked foot-like expansion of that bone. Considering the association with *Phytosaur* remains and the shells of pelecypods and the fact that the specimen shows no evidence of having been transported, it is perhaps not entirely speculation to suggest a shore habitat for *Acompsosaurus*.

Of the relationships of this form but little can be said at this time other than to mention some obvious dissimilarities. Unlike any of the known dinosaurs *Acompsosaurus* has an imperforate acetabulum. While the attachment of the sacral ribs agrees in general with that of the Sauropods, viz., each sacral rib supported by a single vertebra, the sacral expansion of the neural canal found in these dinosaurs is entirely lacking, however, and the modification of all the girdle elements of *Acompsosaurus* is very unlike the condition of this group.

Acompsosaurus has little in common with the *Phytosaurs*. Both forms have two sacral vertebrae, but they are apparently closely united in the form under discussion while in the *Phytosaurs* they are separate. The attachment of the sacral ribs is also very dissimilar in that they are greatly expanded antero-posteriorly and down-curved on the inner side of the ilia in *Acompsosaurus*. The deep acetabulum, the downward plate-like extension of the pubis and the great expansion of the top of the ilium are also in marked contrast to the *Phytosaurian* girdle. Of the other numerous forms that have been described from the Trias of North America the material on which they are based is for the most part of a nature that will not permit a close comparison with *Acompsosaurus*. It is to be hoped that further collections will make possible a further knowledge of this form and help in determining the relationships. The material possibly represents a new group of reptiles but it is thought well to await further evidence before assigning a definite position to this genus in any classificatory scheme.

PHYTOSAUR REMAINS FROM NEW MEXICO.

Walter C. Toepelmann, University of Oklahoma.

The specimen herein described was collected in the fall of 1913 by the University of Chicago paleontological expedition in New Mexico. It was found in the red conglomeratic shales of the Upper Triassic, about three quarters of a mile north-east of Fort Wingate. While the specimen is far from complete, it is of especial interest in as much as it is, perhaps, the most complete record of the phytosaurs from New Mexico.

Palaeorhinus? SP.

The material at hand, specimen No. 1251 U. of C., consists of the left rostral portion of a slender snouted phytosaur and includes the complete premaxilla and the maxilla except for the process of the latter that forms the anterior border of the antorbital foramen. From the tip of the rostrum to the posterior end of the maxilla is a distance of 669 mm. of which the alveolar portion of the premaxilla apparently makes up a little more than half, 330 mm.

Although, as indicated above, the posterior extent of the premaxilla cannot be determined with certainty, its union with the maxilla is probably in the region of the twenty-second alveolus. The anterior end is sharply decurved and extends about 28 mm. below the general palate plane. This decurved portion, however, is not laterally expanded as in *Angistorhinus grandis*. (1). Back from the tip the rostrum decreases somewhat in height. At about 50 mm. from the anterior end, the point of least vertical thickness the measurement is 37 mm. This point also is the start of a vertical swelling, extending posteriorly for about 205 mm. The vertical expansion is slight however; at no place does it increase the height to more than 60 mm. Back from this the rostrum again narrows to about 50 mm. and continues thus to about 300 mm. from the tip. Here

(1) Mehl, M. G., The Phytosauria of the Trias, Vol. 23, No. 2, 1915, p. 154.

the superior border bends abruptly upward into a marked elevation.

Whether this sudden elevation is the rise to the nares or the beginning of a limited but very pronounced crest cannot be determined with certainty. In all probability the former is the case, in that there appears to be a suture separating a triangular splinter of bone along the upper medium side of the rise, the septomaxilla, which would, of course, fix the position of the external nares. The polished surface of a section through this region also indicates the presence of the separate element. Then, too, in all known crested forms the elevation extends well down toward the tip of the rostrum.

The maxilla adds but little information regarding the general shape of the skull and merits little in the way of description.



Fig. 15. *Palaeorhinus?* sp., unerupted tooth, number three from the posterior end of the upper series, about natural size.

THE TEETH.

While the teeth have, with but few exceptions, dropped from the alveoli, something can be said of their size, shape, number and spacing.

The total number of alveoli is forty-two, of which probably twenty-one are on the premaxilla. The decurved tip contains two large circular sockets about 17 mm. in diameter. The next alveolus, situated higher on the jaw than any of the succeeding ones, is somewhat smaller, about 13 mm. The diameter of the fourth and fifth is about 10 mm. The alveoli from the sixth to the twenty-sixth are sub-equal in diameter, averaging about 13 mm. A decrease in size to about 10 mm. follows. In the



Fig. 16. *Pterorhinus?* sp., left lateral view of skull, about one-sixth natural size.

region of the thirty-second alveolus, the diameter increases to 15 mm., which size is maintained to the last. The teeth are rather closely crowded, the interalveolar space averaging 3.5 mm., except in the anterior six where it is from two to three times as great. The prominent ridge along the inner side of the alveoli, so commonly noted in the Phytosauria, extends from the sixth tooth posteriorly until it loses its identity in the region of the thirty-fourth in the form under consideration.

In the preparation of the specimen, a portion of the inner surface of the bone was broken away and an unerupted tooth, the third from the posterior end, exposed. It is typically phytosaurian in its characteristics, being laterally compressed and having finely serrate anterior and posterior edges. The crown appears to have the point directed posteriorly but this is due to the fact that the anterior edge is more highly curved than the posterior. The antero-posterior dimension is slightly greater than 14 mm., the height of crown 19 mm. Part of the outer surface of the tooth adhered to the bone and its character could not be determined, although it apparently was smooth. The tooth is probably characteristic of those in the posterior portion of the jaw.

THE RESTORATION.

In restoring the posterior portion of the skull, a more or less hypothetical procedure, use has been made of the evidence indicating the position of the septomaxilla (and consequently of the anterior border of the nares) as explained above. The alternative, the development of an abrupt vertical crest immediately anterior to the nares, has been discarded since, with this possible exception, no such form is known. The relation of the orbits to the remainder of the cranium is based upon that in *Palaeorhinus bransonii* Williston. (1) In this form these openings are situated slightly posterior to a line drawn perpendicular to the last alveolus, a position essentially the same in all other known forms. The nares in the form at hand are determined by the septomaxilla and would not be much posterior to the present limits of the premaxilla. From the position of these two openings, fixed in the manner described, the other openings and the outline of the skull have been determined. In

(1) Lees, J. H., The Skull of *Palaeorhinus*. *Journal of Geology*. Vol. 15, 1907, pp. 121-150.

restoring the cranium to its probable natural condition, it has been necessary to make the height somewhat greater than shown by Lees. (1) The writer has recently examined the type of *Palaeorhinus* and is of the opinion that the skull has been badly crushed from above. A more accurate restoration would give it considerably more height and also restrict it laterally.

RELATIONSHIPS.

While the specimen at hand is hardly complete enough to merit specific or generic reference, the anterior position of the nares would seem to indicate a rather close relation to *Palaeorhinus*. In the latter, the distance from the anterior tip of the rostrum to the anterior border of the nares is slightly more than half of the total length of the skull; in the present form the corresponding measurement is less than half the length. Furthermore, while the distance from the centre of the orbit to the nares in the former is much less than that in the latter specimen, providing the determination of the position of the two openings is correct in the restoration, in both, the distance is considerably greater than in any other known genus.

From *Palaeorhinus bransoni*, the present form differs in several respects. The more anterior position of the nares, as mentioned above, serves to distinguish the specimen under consideration from the type of *Palaeorhinus* as well as to relate it to the genus. Then, too, in the type, the anterior end of the premaxilla is much less abruptly decurved than in the form at hand and the slight vertical swelling of the latter is lacking in the former. The number of teeth in the two jaws also differs considerably; in *P. bransoni* the total number is 72, or 36 to each side, whereas in the present specimen the total could not be less than 84, or 42 to each side.

Until more is known of this form it may be referred to the genus *Palaeorhinus*.

(1) Op. Cit., p. 124.

EXPLANATION OF PLATES.

Plate I.—Sections of Triassic rocks near Fort Wingate, New Mexico.

Section 1, from about one-half mile southeast of Fort Wingate, northward about five miles.

Section 2, adapted from a section given by G. K. Gilbert from essentially the same region.

Plate II.—*Angistorhinus?* sp. outer view of right ilium, about four-ninths natural size.

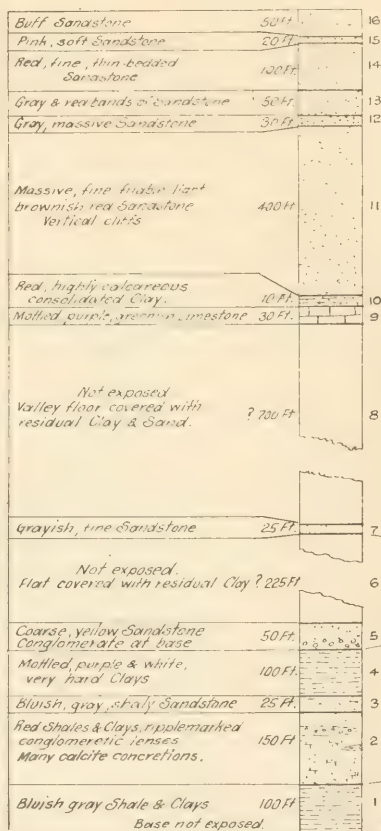
Plate III.—*Acompsosaurus Wingatensis*, right postero-lateral view of pelvic girdle, about one-fourth natural size.

SECTIONS OF TRIASSIC ROCKS

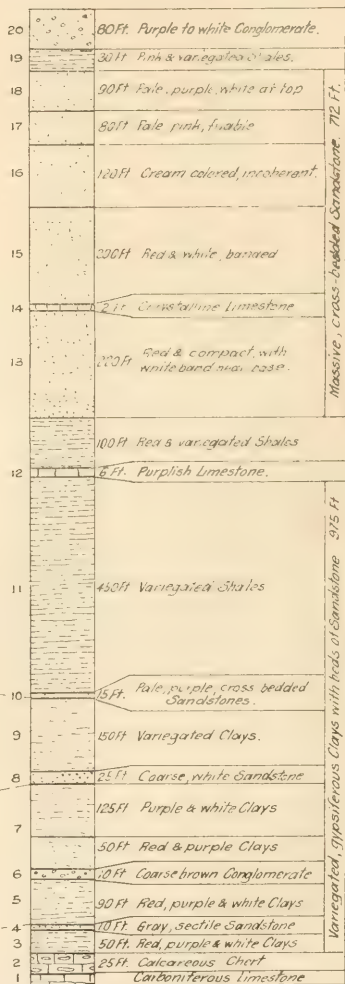
NEAR

Wingate, N. M.

Sec. 1.



Sec. 2. CRETACEOUS COAL MEASURES.







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